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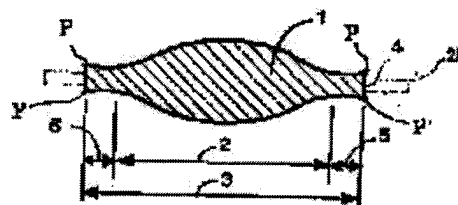
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## (54) OPTICAL ELEMENT

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an optical element having a highly accurate surface in an optical region required for functioning as the optical element.

SOLUTION: The optical element formed by press forming work is provided with an optical region functioning as an optical element, and a continuous surface region having a surface shape which is continued to the surface shape of the optical region on an outer peripheral edge side of the optical region so as not to produce discontinuous points. In order to avoid adverse effects on the optical region from the discontinuous points in the outer peripheral edge of the continuous surface region, the continuous surface region and the optical region are integrally formed by presssing by setting the outer peripheral edge of the continuous surface region apart from the outer peripheral edge of the optical region.



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1. Untranslatable words are replaced with asterisks (\*\*\*\*).
2. Texts in the figures are not translated and shown as it is.

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Dictionary: Last updated 10/12/2007 / Priority: 1. Mechanical engineering / 2. Mathematics/Physics / 3. Electronic engineering

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**FULL CONTENTS**

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**[Claim(s)]**

[Claim 1] The optical field part which functions as an optical element in the optical element fabricated by press-molding processing, Have the continuation side field part which has the shape of a surface type made to continue so that the shape of a surface type and discontinuous point of said optical field part may not be produced on the perimeter veranda of said optical field part, and [ said continuation side field part ] The optical element characterized by for the perimeter edge of the continuation side field part having kept spacing from the perimeter edge of said optical field part, and carrying out press-molding processing of said continuation side field part and the optical field part in one so that the adverse effect from the discontinuous point of the perimeter edge of the continuation side field part concerned may not attain to said optical field part.

[Claim 2] It is the optical element according to claim 1 characterized by the shape of a surface type of a continuation side field part being the face shape extended with the function showing the shape of a surface type of an optical field part.

[Claim 3] The optical element according to claim 1 or 2 characterized by preparing a shading means in the incidence side of the continuation side field part concerned so that a beam of light may not be entered in a continuation side field part.

[Claim 4] A shading means is an optical element according to claim 3 characterized by being the gobo prepared in the incidence side of a continuation side field part, or the shading coating applied to the incidence side of a continuation side field part.

[Claim 5] An optical field part is an optical element given in any of Claim 1 or Claim 4 which are characterized by being the configuration of rotation symmetry and a continuation side field part having the shape of an annulus involving the perimeter edge of said optical field part they are.

[Claim 6] An optical element given in any of Claim 1 or Claim 5 which are characterized by preparing the edge material by which the portion was inserted and fixed to the continuation

side field part concerned in the perimeter edge of a continuation side field part they are.

[Claim 7] The portion where edge material was inserted is an optical element according to claim 6 characterized by being a wedge shape in the thickness direction cross section of a continuation side field part.

[Claim 8] Some heads where edge material was inserted are the optical elements of Claim 7 characterized by being the configuration from which the derivative of wedge-shaped thickness is set to 0.

[Claim 9] The optical element according to claim 1 or 2 characterized by excising said continuation side field part after press-molding processing of a continuation side field part and the optical field part is carried out in one.

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#### [Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to optical elements fabricated by press-molding processing, such as a lens, a mirror, etc. which are used for optical apparatus.

[0002]

[Description of the Prior Art] Press-molding processing is raised to one of the methods of processing an optical element. This press-molding processing is the processing method which transfers the optical element configuration which poured into the form block demineralizing and the element material by which melting was carried out, applied the pressure, and was processed into the form block by heat.

[0003] Drawing 6 is the sectional view showing the press-molding processing method of the conventional optical element (aspheric-surface shaping lens). The lens for which the cope of a form block is fabricated 17 in drawing, and 18 is fabricated as an optical element a bottom type and 19, and 20 are the extrusion parts of the lens 19 which was missed between cope 17 and bottom type 18, and was protruded into the gap by application of pressure. Post forming deletion of this extrusion part 20 is carried out. P in drawing is a discontinuous point produced on the perimeter veranda of a lens 19. This discontinuous point P is produced, when it overflows with the surface of a lens 19 and the even surface of a part 20 is not continuing smoothly. [ press-molding processing ] between the fields of the up-and-down die of cope [ which faces in parallel ] 17, and bottom type 18 generally It is never unavoidable that overflow into the perimeter veranda of a lens 19 with the surface of the lens 19 concerned, and the discontinuous point P arises on a boundary with the surface of a part 20 on the connection which the raw material pressurized overflows a little and which must miss, and must prepare and fabricate a gap.

[0004]

[Problem to be solved by the invention] [ the lens 19 by the above press-molding processings ]

Since dissolution of the discontinuous point P produced on the perimeter edge of a lens 19 was difficult, in the adjacent spaces of this discontinuous point P, the optical field part which wants to function as a lens 19 especially, and this example, there was a problem that the profile irregularity of the field by the side of the core of a lens 19 worsened from the discontinuous point P. Since centralization of the pressure added at the time of a form takes place easily in the discontinuous point P, a pressure does not become uniform in the perimeter, but the field where sufficient pressure for a form is not obtained occurs. It is because the shape of a surface type of form blocks 17 and 18 is not correctly transferred by the lens 19, or the field where the pressure as internal stress remains generates after a form in a lens 19 and distortion arises.

[0005] This invention was made in order to solve the above problems, and it aims at offer of an optical element with the high profile irregularity fabricated so that the adverse effect by a discontinuous point might not attain to an optical field part.

[0006]

[Means for solving problem] In the optical element by which this invention is fabricated by press-molding processing It has the optical field part which functions as an optical element, and the continuation side field part which has the shape of a surface type made to continue so that the shape of a surface type and discontinuous point of said optical field part may not be produced on the perimeter veranda of said optical field part. Said continuation side field part makes it the content for the perimeter edge of the continuation side field part to have kept spacing from the perimeter edge of said optical field part, and to have carried out the fabricating operation of said continuation side field part and the optical field part in one so that the adverse effect from the discontinuous point of the perimeter edge of the continuation side field part concerned may not attain to said optical field part.

[0007] Moreover, this invention makes it the content for the shape of a surface type of a continuation side field part to be the face shape extended with the function showing the shape of a surface type of an optical field part.

[0008] Moreover, this invention makes it the content to have prepared the shading means in the incidence side of the continuation side field part concerned so that a beam of light might not be entered in a continuation side field part.

[0009] Moreover, this invention makes it the content for a shading means to be the gobo prepared in the incidence side of a continuation side field part, or the shading coating applied to the incidence side of a continuation side field part.

[0010] Moreover, an optical field part is the configuration of rotation symmetry, and this invention makes it the content for a continuation side field part to have the shape of an annulus

involving the perimeter edge of said optical field part.

[0011] Moreover, this invention makes it the content to have prepared the edge material which the portion was inserted in the continuation side field part concerned, and was fixed to the perimeter edge of a continuation side field part.

[0012] Moreover, the portion where edge material was inserted as for this invention makes it the content to be a wedge shape in the thickness direction cross section of a continuation side field part.

[0013] Moreover, this invention makes it the content to have excised said continuation side field part, after press-molding processing of a continuation side field part and the optical field part is carried out in one.

[0014]

[Mode for carrying out the invention] The lens as an optical element is made into an example, and the form 1 of form 1. implementation of operation is explained based on drawing 1 .

Drawing 1 is the sectional view of a lens. In drawing 1 , it is the optical field part as an optical effective diameter required in order that 1 may achieve a lens and 2 may achieve performance expected [ as an optical element ] in a lens 1, i.e., the field part which refracts for it and reflects a beam of light.

[0015] 5 is the continuation side field part fabricated in the shape of an annulus in [ the perimeter veranda of the optical field part 2 of a lens 1 / as the optical field part 2 concerned ] one. In addition, 3 shows the path of a lens 1 which has the continuation side field part 5 in the optical field part 2. The shape of a surface type of the continuation side field part 5 is made into the surface face shape which continues smoothly so that the shape of a surface type and discontinuous point of the optical field part 2 may not be produced. A concave side configuration or convex form is [ that the shape of this surface type should just be the face shape extended with the function showing the shape of a surface type of the optical field part 2, for example ] sufficient as that face shape.

[0016] Thus, [ a lens 1 ] so that the optical field part 2 of the configuration of rotation symmetry and the continuation side field part 5 of the shape of an annulus involving the perimeter veranda of the optical field part 2 concerned may be fabricated in one To the form block (die) beforehand made into the suitable configuration, as an element material, for example, by pouring in and pressurizing plastic and glass by which melting was carried out The inside of the field of the optical field part 2 can apply a uniform pressure from the first to the shape of a surface type by the side of the continuation side field part 5, i.e., the internal periphery of the continuation side field part 5, which met the optical field part 2 concerned at least. In this case, the perimeter edge 4 of the continuation side field part 5 keeps sufficient spacing from the perimeter edge of the optical field part 2, and fabricates the width of the continuation side field part 5 broadly so that the adverse effect from the discontinuous point P produced on the

perimeter edge of the continuation side field part 5 may not attain to the optical field part 2.

[0017] Thereby, birth of distortion by the lack of a pressure and pressure centralization at the time of a form can be made to be able to cancel, and surface face shape can be made to transfer [ in / at least / the optical field part 2 ] correctly. Therefore, a pressure excessive as internal stress is not made to remain after a form. On the other hand, the adverse effect by the discontinuous point P produced in the perimeter edge 4 side of the continuation side field part 5 is less than the optical field part 2 by fully taking the width of the continuation side field part 5. In this way, the profile irregularity of the optical field part 2 can be maintained highly.

[0018] Drawing 2 is drawing having shown the distribution of errors of the thickness to the radii of the lens 1 shown in drawing 1 by which press-molding processing was actually carried out. In addition, it is the aberration correcting lens which has an aspheric-surface configuration in both sides, the ratio of a diameter D to thickness l is about 100, and this lens 1 is  $D \gg l$ . Moreover, it is  $r(D/2) = 14.8\text{mm}$  in radii of a lens 1. In drawing 2, it turns out that distribution spread remarkably at  $r \leq 12\text{mm}$ , and profile irregularity has deteriorated under the effect of the discontinuous point P ( drawing 1 ) produced on the perimeter edge 4 of a lens 1. In this example, the distance from the core shall be the radii  $r_o$  of the optical field part 2 12mm or less by  $r_o = r/1.2$ , and the die length (distance) from the width of the continuation side field part 5, i.e., the perimeter edge of the optical field part 2, to the perimeter edge 4 of the continuation side field part 5 has been 2.8mm. Thus, the adverse effect by the above-mentioned discontinuous point P of the continuation side field part 5 is kept from attaining to the optical field part 2 by making the radii of the continuation side field part 5, i.e., the radii of a lens 1, into the magnitude which exceeds about 1.2 times to the radii of the optical field part 2.

[0019] As an ingredient of a lens 1, there are plastic and glass as an element material with an easy form with high thermoplasticity. By using these element materials, optical elements, such as a high-precision lens and a mirror, can be fabricated comparatively easily. Moreover, approaches, such as press molding cooled while paying the element material softened with heat as the form approach to the form block which consists of two fluctuated type dies, for example and applying a pressure, are the optimal.

[0020] By fabricating in one the continuation side field part 5 which has the shape of a surface type which follows smoothly the shape of a surface type of the optical field part 2 according to the form 1 of this operation [ with centralization of the pressure added at a discontinuous point at the time of a form ], the adverse effect by a discontinuous point, shape of i.e., a surface type, of a field Surface type-like transfer can become inaccurate, or a pressure can remain as internal stress, after a form can cancel inconvenience, such as producing distortion, and the lens 1 with high profile irregularity as a design can be offered.

[0021] Moreover, although the lens 1 was made into the example as an optical element, the profile irregularity of the optical field part 2 can be made to hold highly similarly about other

optical elements, such as a mirror (reflector), with the form 1 of this operation. Moreover, the same operation effectiveness is acquired also to which optical elements, such as a visible region, an ultraviolet region, and an infrared field.

[0022] The form 2 of form 2. implementation of operation is explained based on drawing 3. Drawing 3 is the sectional view of a lens. In addition, the same code as the code used with the form 1 of the above-mentioned implementation is the same content. In drawing, six in drawing is edge material. This edge material 6 is fabricated by the perimeter edge 4 of the continuation side field part 5 in one. The edge material 6 of the graphic display is annularly fabricated so that the perimeter edge 4 may be traveled, and the internal periphery side which is a part of this edge material 6 is being inserted and fixed in the diameter direction of the lens 1 concerned to the perimeter edge 4 concerned. The inserted point is also hereafter called insertion head. It is embedded slightly and is being fixed.

[0023] The edge material 6 can be made for a necessary configuration, for example, by fabricating in the shape of an annulus as mentioned above, and set and pressing in a form block with a lens material at the time of press-molding processing of a lens 1, to unify comparatively easily beforehand using the proper member which has sufficient rigidity, for example. In this case, the insertion head of the edge material 6 arranges so that it may stop at the continuation side field part 5 of a lens 1 and the optical field part 2 may not be reached. Although this insertion head serves as a discontinuous point By making an insertion head sharp so that it may become a sharp wedge shape, for example in the cross section of the thickness direction of the continuation side field part 5 The adverse effect can be made small and the adverse effect by the discontinuous point at the head of insertion concerned can be mostly lost because the derivative to the thickness of the wedge shape concerned considers it as the configuration which becomes 0 at the insertion head further.

[0024] While being able to raise the reinforcement of the lens 1 by the form 1 of operation by forming the edge material 6 in the perimeter edge 4 side of the continuation side field part 5 of a lens 1 according to the form 2 of this operation In press-molding processing, the screw hole for lens mounting where it is difficult to create on the lens concerned can be easily created to the edge material 6 concerned. In addition, although the edge material 6 explained the shape of an annulus as a premise in the form 2 of this operation, it can be used not only as the shape of an annulus but as an arc type or a card form, and can also be suitably arranged in a part of perimeter edge 4 or about two or more copies.

[0025] The form 3 of form 3. implementation of operation prepares a shading means in the incidence side of the continuation side field part 5 concerned so that a beam of light may not be entered in the continuation side field part 5. This is explained based on drawing 4. Drawing 4 is the sectional view of a lens. In addition, the same code as the code used with the forms 1 to 2 of the above-mentioned implementation is the same content.



[0026] Seven in drawing is a gobo as a shading means. Although it is desirable to be arranged so that the beam of light which enters into fields other than optical field part 2 of a lens 1 may be interrupted as for this gobo 7, it is arranged at least in the example of the graphic display at the incidence side of the continuation side field part 5 concerned so that a beam of light may not enter into the continuation side field part 5. This gobo 7 is fabricated in the shape of [ according to the configuration of the continuation side field part 5 ] an annulus, and it is being fixed using the proper adhesive bond etc. so that the incidence side of the continuation side field part 5 may be covered. However, it is not necessary to necessarily fix a gobo 7 to the continuation side field part 5 directly.

[0027] Since the configuration design of the continuation side field part 5 is not optically carried out on the outside of the optical field part 2, the beam of light which passes through this field becomes the cause of degrading image formation performance. For this reason, by forming the above gobos 7, the beam of light which penetrates the continuation side field part 5 which has not been designed optically can be intercepted, and the lens 1 equipped with the engine performance as a design can be obtained.

[0028] Drawing 5 is the diagrammatic chart which showed the result of having verified the effectiveness of the lens 1 equipped with such a gobo 7 by determination. The axis of abscissa of a diagrammatic chart is spatial frequency which an image has. An axis of ordinate is the ratio (MTF ratio) of MTF of an optical system in case a beam of light penetrates the MTF [ of an optical system ] (Modulation Transfer Function), and continuation side field part 5 whole set up to penetrate only the optical field part 2 using a gobo 7. It is shown that image formation performance of an MTF ratio improved by using a gobo 7 when this diagrammatic chart had an MTF ratio larger than 1 in order to take such a big value that image formation performance is high in 0 to 1. In addition, on the frequency between [ of about zero spatial frequency ] low altitudes, drawing 5 shows that image formation performance improved 20 to 30% on the whole, although effectiveness is small, since the difference of the engine performance by an optical system generally does not appear easily.

[0029] With the form 3 of this operation, although the gobo 7 was formed as a separate part of another object in the lens 1 as a shading means, the same operation effectiveness can be acquired also by applying to fields 5 other than optical field part 2 of a lens 1, i.e., a continuation side field part, the coating which does not penetrate a beam of light, for example.

[0030] The form 4 of form 4. implementation of operation excises the continuation side field part 5 for the lens 1 fabricated like the form 1 of the above-mentioned implementation after a form, and uses it as the lens (not shown) equipped only with the optical field part 2. [ namely, the form block (not shown) processed so that the continuation side field part 5 which has the shape of a surface type which follows the perimeter veranda of the optical field part 2 which functions as an optical element so that the shape of a surface type and discontinuous point of

this optical field part 2 may not be produced might be fabricated in one ] For example, it cools, while thermoplasticity pays element materials, such as high plastic with an easy form, and glass, to the form block which consists of two fluctuated type dies and applies a pressure, and the lens 1 equipped with the continuation side field part 5 is fabricated. In this way, the continuation side field part 5 of the fabricated lens 1 is excised with a proper means, and it is considered as the lens (not shown) equipped only with the optical field part 2.

[0031] the lens 1 of the form 1 of the operation which the residual pressure has produced in neither distortion nor a core according to the form 4 of this operation -- that is, Since the continuation side field part 5 which cannot function as a lens among the lenses 1 equipped with the optical field part 2 and the continuation side field part 5 was excised by the proper means, the lens of a byway with the highly precise field equipped only with the optical field part 2 which functions as a lens can be offered.

[0032] In addition, although the forms 1 to 4 of the above-mentioned implementation explained the lens 1 as an example as an optical element, it is the same also about other optical elements, such as not only this but a mirror (reflector).

[0033]

[Effect of the Invention] In the optical element which is fabricated by press-molding processing according to this invention It has the optical field part which functions as an optical element, and the continuation side field part which has the shape of a surface type made to continue so that the shape of a surface type and discontinuous point of said optical field part may not be produced on the perimeter veranda of said optical field part. [ said continuation side field part ] so that the adverse effect from the discontinuous point of the perimeter edge of the continuation side field part concerned may not attain to said optical field part Since the perimeter edge of the continuation side field part kept spacing from the perimeter edge of said optical field part and fabricated said continuation side field part and the optical field part in one, the field of an optical field part optical elements, such as a lens equipped with the engine performance as a highly precise design, offer [0034] Moreover, according to this invention, the beam of light which penetrates the continuation side field part which has not been designed optically can be intercepted, and the lens equipped with the engine performance as a design can be offered.

[0035] Moreover, according to this invention, since it is the gobo prepared in the incidence side of a continuation side field part, or the shading coating applied to the incidence side of a continuation side field part, the shading means can intercept the beam of light which penetrates the continuation side field part which has not been designed optically, and can offer the lens equipped with the engine performance as a design.

[0036] Moreover, since according to this invention an optical field part is the configuration of rotation symmetry and a continuation side field part has the shape of an annulus involving the

perimeter edge of said optical field part, optical elements, such as a lens with a highly precise field of an optical field part and a mirror, can be offered.

[0037] Moreover, since the edge material which the portion was inserted in the continuation side field part concerned, and was fixed to the perimeter edge of a continuation side field part was prepared according to this invention While being able to raise the reinforcement of an optical element, in press-molding processing, the screw hole for mounting where it is difficult to create can be easily created to the edge material concerned.

[0038] Moreover, according to this invention, since the portion where edge material was inserted is a wedge shape in the thickness direction cross section of a continuation side field part, it can make small the adverse effect by the discontinuous point at this head of insertion.

[0039] Moreover, according to this invention, since the derivative of wedge-shaped thickness is a configuration used as 0, some heads where edge material was inserted can make still smaller the adverse effect by the discontinuous point at this head of insertion.

[0040] Moreover, according to this invention, after fabricating a continuation side field part and an optical field part in one, the field of an optical field part can offer optical elements, such as a byway lens, with high degree of accuracy by excising the continuation side field part concerned.

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#### [Brief Description of the Drawings]

[Drawing 1] It is the sectional view of the lens of the form 1 of operation.

[Drawing 2] It is drawing having shown the distribution of errors of the thickness to the radii of the lens of the form 1 of operation.

[Drawing 3] It is the sectional view of the lens of the form 2 of operation.

[Drawing 4] It is the sectional view of the lens of the form 3 of operation.

[Drawing 5] It is the diagrammatic chart which showed the result of having verified the effectiveness of the lens of the form 3 of operation by determination.

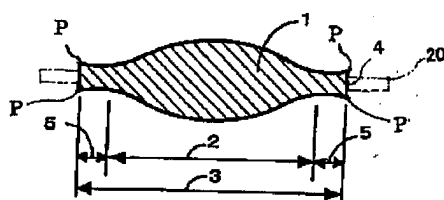
[Drawing 6] It is the sectional view having shown the conventional lens form approach.

#### [Explanations of letters or numerals]

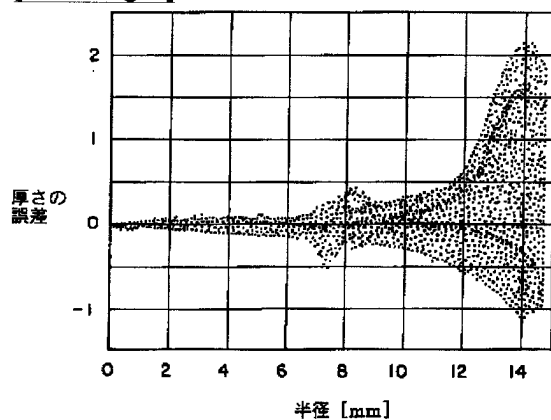
1 A lens, 2 An optical field part, 4 A perimeter edge, 5 A continuation side field, 6 Edge material, seven gobos (shading means), P Discontinuous point.

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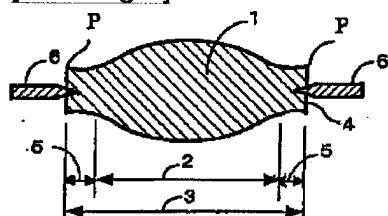
[Drawing 1]



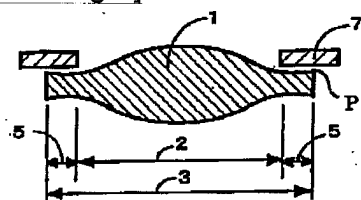
[Drawing 2]



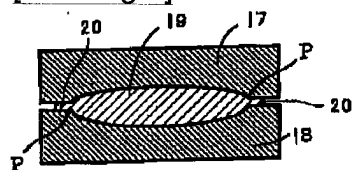
[Drawing 3]



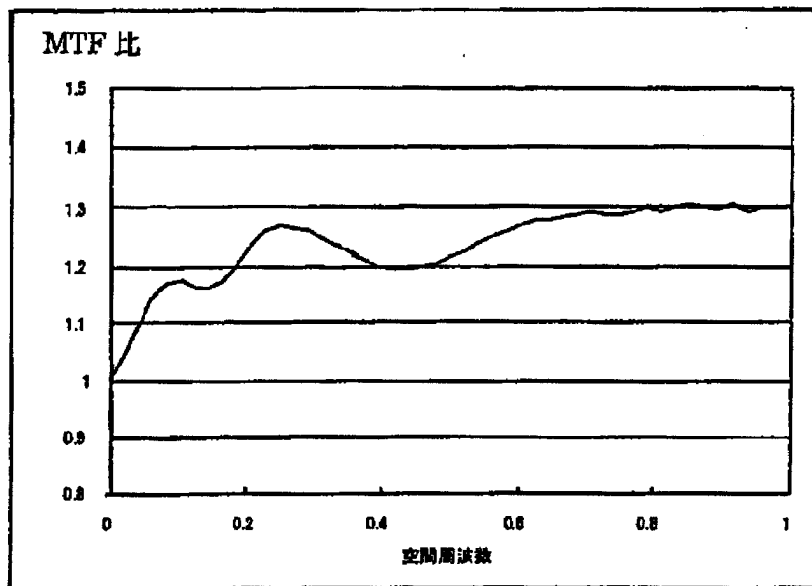
[Drawing 4]



[Drawing 6]



[Drawing 5]



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[Translation done.]